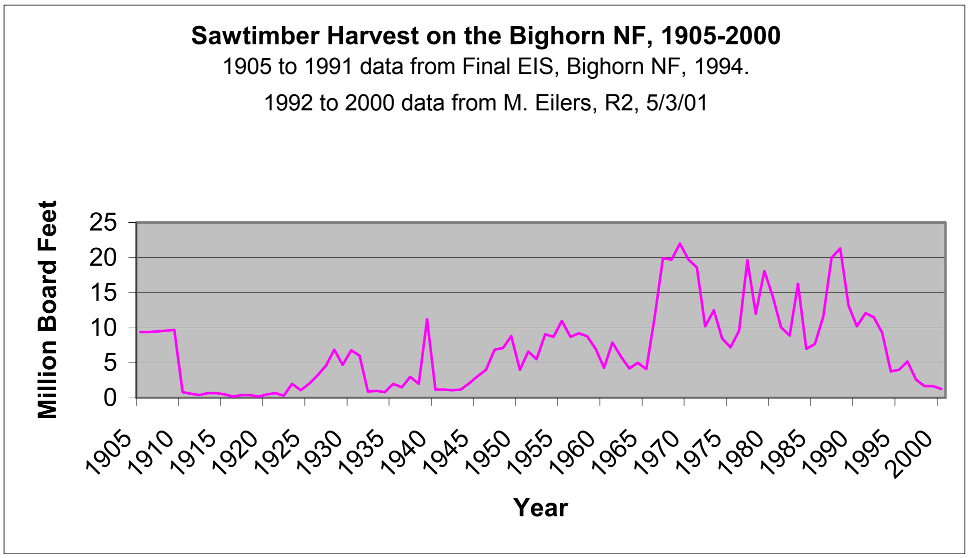
Forested Vegetation - General

PAST DISTURBANCES: TIMBER HARVEST

Timber harvest has occurred in the Big Horn mountains as long as people have lived in this area. Native Americans utilized the extensive lodgepole forests for tepee poles, a practice which continues to this day. Wood from along the edges of the forest was harvested by European people for forts, fuelwood and construction material beginning in the 1860s. When European settlement began in earnest in the 1890s, sawmills sprang up around the forest to supply wood products. The Tongue River area, particularly the

Table 1. Sawtimber Harvest on the Bighorn National Forest, 1905-2000



South Tongue was the site of extensive tie-hack operations between about 1891 and 1910. Tie hacking lasted about a decade beginning in about 1925 above Buffalo, centered on Sourdough Creek. Timber harvest continued through the 1940s and 1950s, but the largest period of harvest began after 1963, when Wyoming Sawmills, Inc. opened in Sheridan.

Harvest levels averaged 14 million board feet between 1966 and 1992, but have dropped since the mid-1990s. The Bighorn National Forest has offered an annual average of just less than 3 MMBF of sawtimber since 1994. The 1985 Forest Plan estimated an average Allowable Sale Quantity (ASQ) of approximately 14.5 MMBF of live sawtimber between 1991 and 2000. Beginning in the 1987 monitoring report, it was documented that the ASQ was not achievable with the standards and guidelines in the Forest Plan.

Table 2 shows the acreage amount of timber harvest, fire, and blowdown on the Bighorn National Forest. This table does not include tie hacking, and the pre-1960s data is not considered to be accurate. Data is from the Forest's activity database.

Table 2. Timber Harvest, fire and blowdown on the Bighorn NF

Harvest Type	Pre-1960's	1960's	1970's	1980's	1990's	2000
Clearcut	840	9683	6199	4139	1892	7
Shelterwood: Prep Cut	152	255	8939	10003	519	
Shelterwood: Seed Cut			519	3935	1428	895
Shelterwood: Overstory Removal		399	1418	1149	1027	
Seed Tree	2236	30	386	40	54	
Selection			1081	949	92	
Commercial Thin	1036		900	2105	186	
Sanitation/Salvage			710	3474	2321	
Pre-commercial Thin		2537	1811	11776	1109	
Fire[1]	1901	85	2366	13339	2976	
Blowdown[2]				581	4500[3]	
Acres CC + SW + ST + S + S/S[4]	3228	10367	19252	23652	7333	902

The primary harvest systems on the Bighorn NF have changed over time since the 1960s in what some have termed "the silviculture of the decade", as shown in Table 3. The primary system in the 1960s was clearcutting. Clearcuts practiced in the 1960s and early 1970s on the Bighorn were typically several hundred acres and occurred almost exclusively in lodgepole pine. Those areas have subsequently grown into sapling –pole sized stands that are up to 30 feet tall, regenerated almost exclusively to lodgepole pine, provide excellent hiding cover, and recently have been the focus of the precommercial thinning program. The amount of transitory forage for livestock has been decreasing as the forests have regenerated. Tongue River and Crazy Woman Creek were the primary locations of this activity, although lesser amounts also occurred in Tensleep Creek and the upper reaches of Little Bighorn.

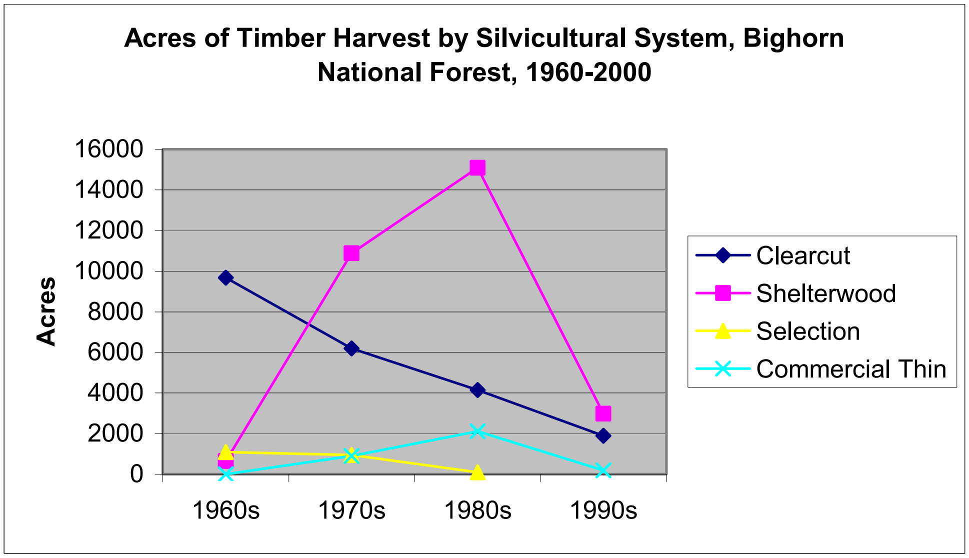
[1] This is not the most complete fire information, especially prior to 1960. The fire database, summarized elsewhere in the existing condition assessment, is more complete for wildfire.

[2] Several blowdowns totaling several hundred acres are not included in this database: Ranger Creek, Shell Creek, and Willett Creek.

[3] The 1991 Tongue Blowdown affected approximately 1500 acres over a 6 mile long area, and the 1993 blowdown affected an estimated 3000 acres across the Forest. The most concentrated area was in the Little Bighorn River geographic area.

[4] CC = Clearcut, SW = Shelterwood, ST = Seed Tree, S = Selection, S/S = Sanitation/Salvage. These were summed to portray the amount of sawlog harvest that has occurred.

Table 3. Acres of Timber Harvest by Silvicultural System by decade



In response to national issues on the Monogahela and Bitterroot National Forests, the use of clearcutting declined throughout the National Forest System in subsequent decades, including the Bighorn NF. Another even-aged harvest system, shelterwood, was the primary harvest system between the mid-1970's to the early to mid-1980's. During the early 1980's, another major shift in harvest system occurred throughout the National Forests in Colorado and Wyoming in an effort to improve elk habitat. A prescription of 10 to 40 acre clearcuts was thought to provide an optimal ratio of cover to forage, and that system was the predominant one applied on the Bighorn NF between the mid-1980's up to about 1990. While small amounts of other harvest systems were used throughout these three major harvest "periods", it is apparent that harvest systems applied between 1960 and 1990 were more influenced by "the science and social issues" of the time as opposed to site and project specific issues and resources.

Salvage of the 1991 and 1993 blowdowns, and the Intermission (1988) and Gloom Salvage (1992) fires, were large contributors to the Bighorn NF harvest program in the early part of the 1990s.

Ecological thinking in the latter part of the 1990s has centered on the idea that timber harvest that emulates the natural disturbance pattern of an ecosystem may be the best way of providing for sustainability (Knight, et al, 2000). This concept was considered in the recent Sourdough timber sale analysis where larger scale clearcuts were among the alternatives considered.

The following three tables portray the timber harvest history since 1960 for the three primary commercial forest cover types: Douglas-fir (table 4), lodgepole pine (table 5), and Engelmann spruce-subalpine fir (table 6).

Table 4. Douglas-fir Timber Harvest History since 1960

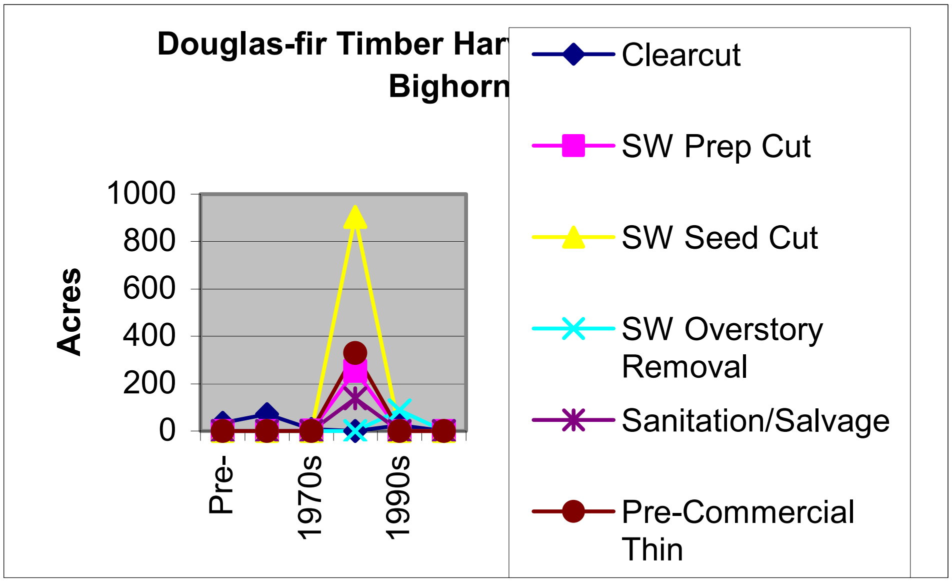
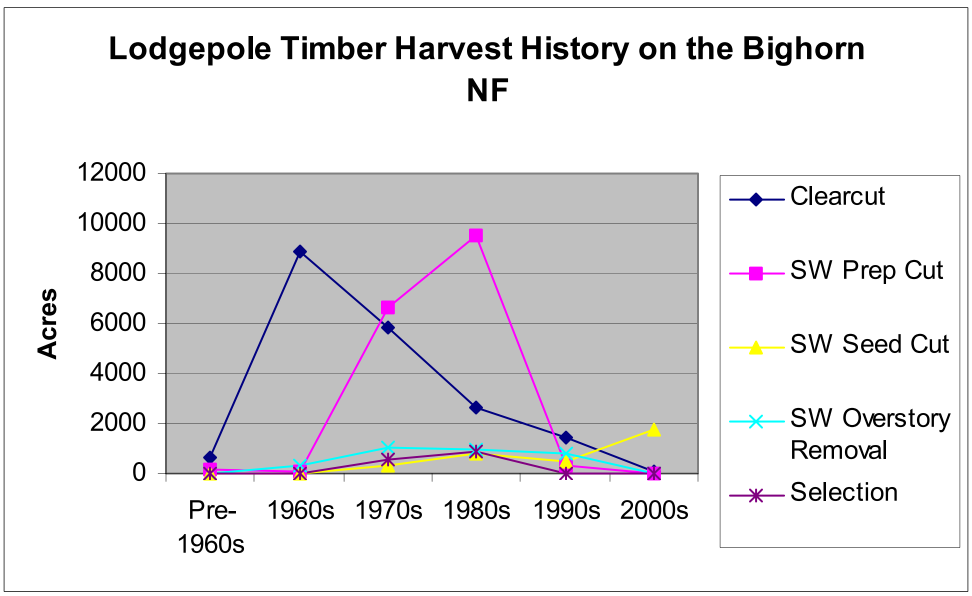


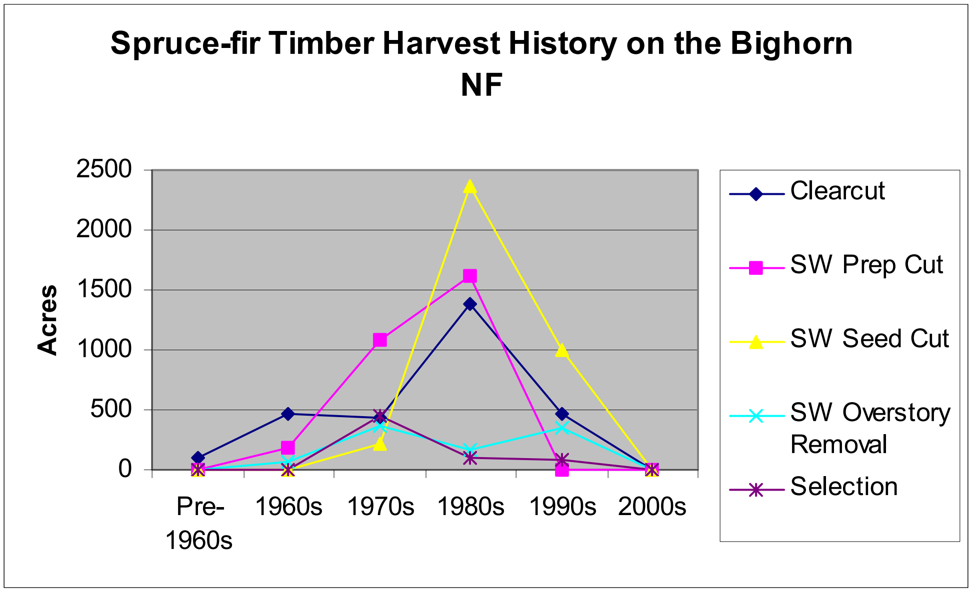
Table 5. Lodgepole Pine Timber Harvest History since 1960



Among the conclusions that can be drawn from these tables are:
Lodgepole has been the primary species of timber harvest on the Bighorn NF since 1960.

Spruce-fir and Douglas-fir harvests were increased in the 1980s.
Table 5 shows how silvicultural systems on the Bighorn NF changed over time in response to scientific and social issues, as evidenced by the shift from clearcutting in the 1960s to a preponderance of shelterwood prep cuts in the 1980s.

Table 6. Spruce-fir Timber Harvest History since 1960



Timber suitability is one of the primary determinations made in Forest Plans, and is described at 36 Code of Federal Regulations 219.14:

During the forest planning process, lands that are not suited for timber production shall be identified in accordance with the following criteria:
The land is not forested; technology is not available to harvest without irreversible damage to soils and watershed; there is not reasonable assurance that restocking can occur in accordance with 219.27 (5 years, etc.); land has been withdrawn by Congress, Secretary of Agriculture or Chief.
Forestlands remaining shall be reviewed to determine the costs and benefits for a range of management intensities for timber production.
Consider other multiple use benefits, including recreation, timber, watershed, range, wildlife and fish, and wilderness.

While timber harvesting may occur on lands not suited for timber production, it must be for resource objectives other than timber production.

The 1985 Forest Plan included 266,439 acres suited for timber production. A suitability reanalysis was completed as part of the Sierra Club 7 year regeneration lawsuit in 1991, which resulted in 262,062 acres suited for timber production. A redetermination of the lands suited for timber production will be conducted as part of the plan revision. While minor changes in the redetermination may occur as part of increased scientific knowledge or regeneration experience, the primary changes are expected from changes in resource priority allocations.

Table 7 shows the relative amounts of lands suited for timber production by geographic area. This can be considered the relative amounts of the areas that are "available" for commercial wood production purposes.

Table 7. Percent of Forested Area that is Suited for Timber Produciton by Geographic Area

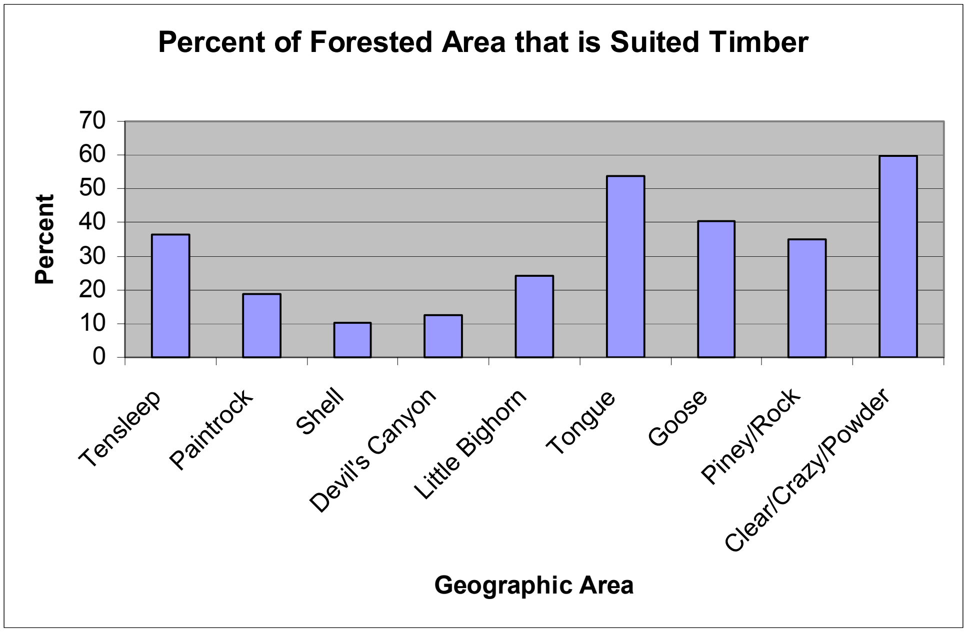
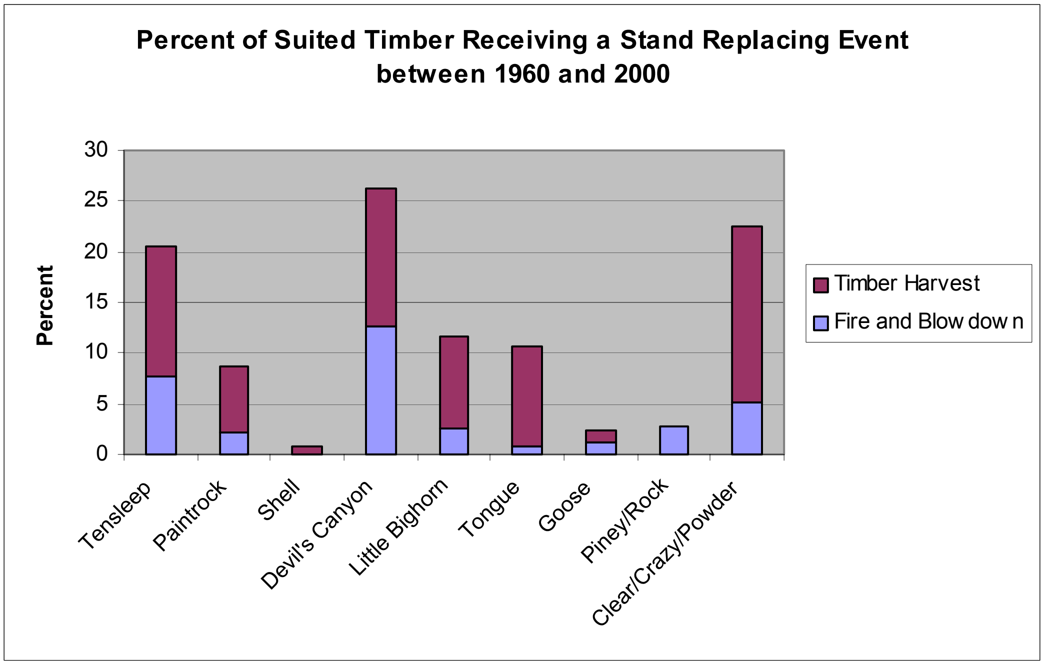


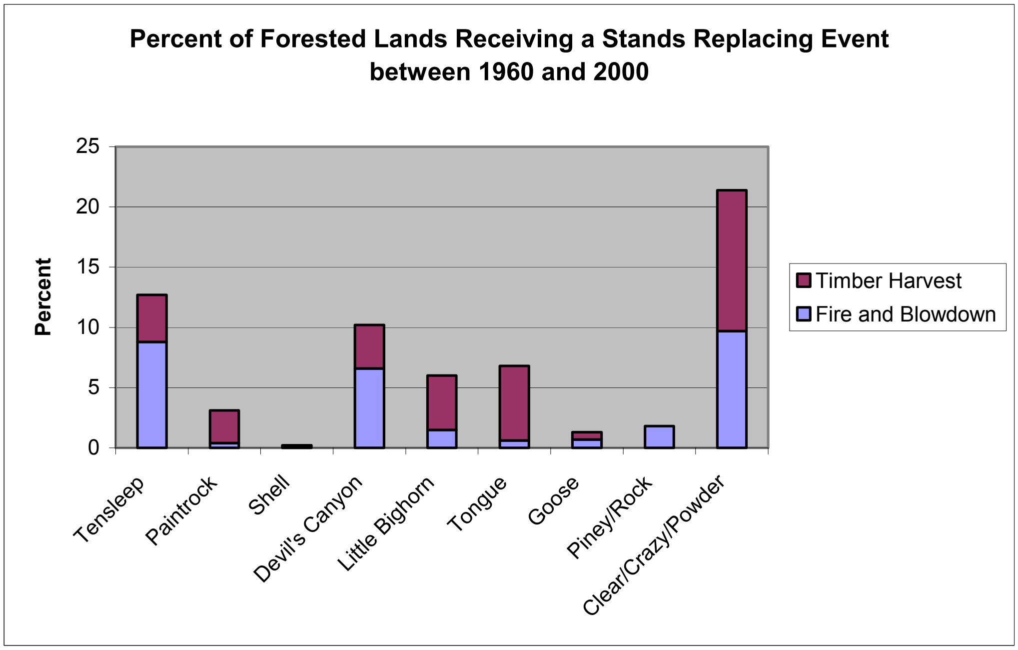
Table 8 and Table 9, which show the percentage of land suited for timber production and total forest land that received a "stand replacing event"[5] between 1960 and 2000, show the relative "intensity" of forest change during that period.

Figure 8. Percent of Lands Suited for Timber Production Receiving a Stand Replacing Event, 1960-2000



[5] A stand replacing event is considered to be a stand originating event, and is defined for this analysis as: clearcuts; shelterwood seed and overstory removal cuts; selection; fires; blowdowns; seed tree.

Table 9. Percent of All Forested Lands Receiveing a Stand Replacing Event, 1960-2000



Among the conclusions that can be drawn from these tables are:
Approximately 39% of the suited timber land and 14% of the total forested land on the Bighorn NF has received timber harvest since 1960[6]. These numbers are an overestimate, because some acres received more than one treatment, such as a shelterwood harvest followed later by a clearcut.
The intensity of past timber harvest varies by geographic area. Nearly 13% of the forested lands in the Clear/Crazy/Powder area received timber harvests between 1960 and 2000, as opposed to only 1% of the forested area in Shell Creek geographic area.

VEGETATION

Composition, distribution, and abundance of the major vegetation types and successional stages of forest and grassland systems

Table 10 shows the major vegetation cover types that occur on the Bighorn National Forest. Non-vegetation includes rock and bare areas according to common vegetation unit definitions. This information for each geographic area is included in the individual geographic area assessments.

[6] These figures are from K:\res\forest_plan\plan_revision\219-28_timber_suit\11_2001_Activities.xls and K:\res\forest_plan\plan_revision\219-28_timber_suit\Regulation_Analysis.xls.

Table 10. Vegetation Cover Types on the Bighorn National Forest

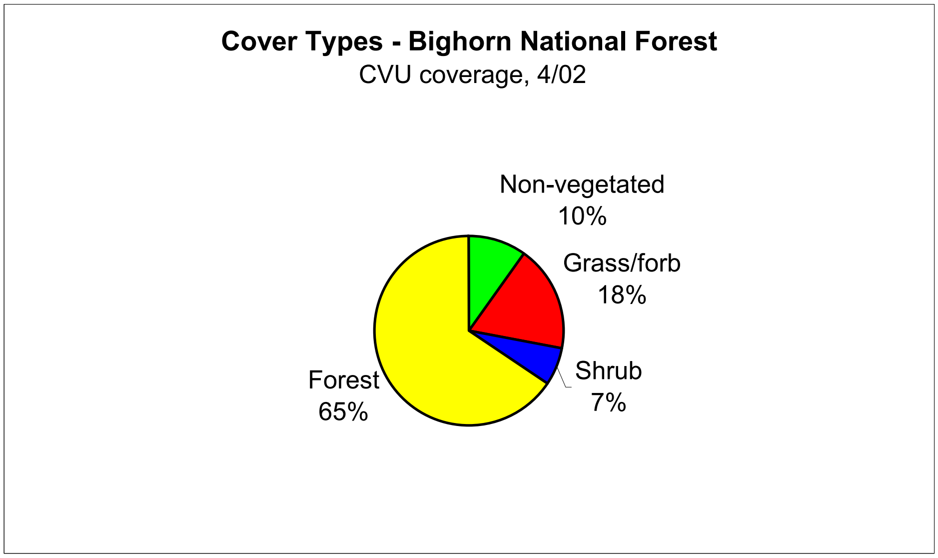
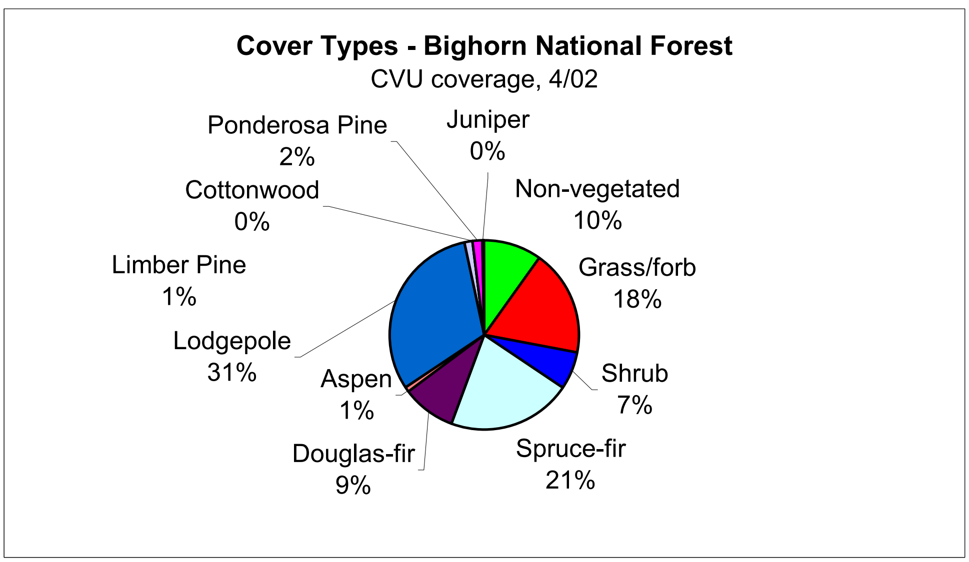


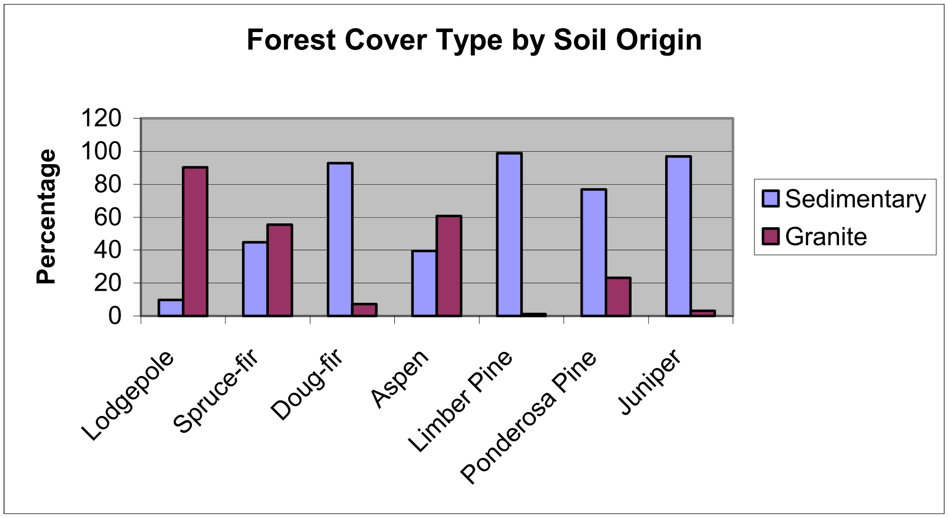
Table 11 shows the relative amounts of the dominant cover types on the Bighorn National Forest. Other species exist on the NF, but were not of sufficient size and scale to be the dominant cover type in a common vegetation unit polygon. This information for each geographic area is included in the individual geographic area assessments.

Table 11. Vegetation Cover Types on the Bighorn National Forest



The distribution of vegetation varies considerably by geographic area, as influenced by such environmental variables as precipitation, elevation, topographic, and soil features. Table 12 shows how the forested vegetation cover types vary by soil substrate. More information on this topic, and how other environmental factors influence the composition, structure and function of individual forest species is included in each species report. With the exception of spruce-fir and aspen, the distribution of forest cover types on the Bighorn National Forest can largely be explained by the soil substrate (Despain, 1973).

Table 12. Distribution of Forest Cover Type by Soil Substrate



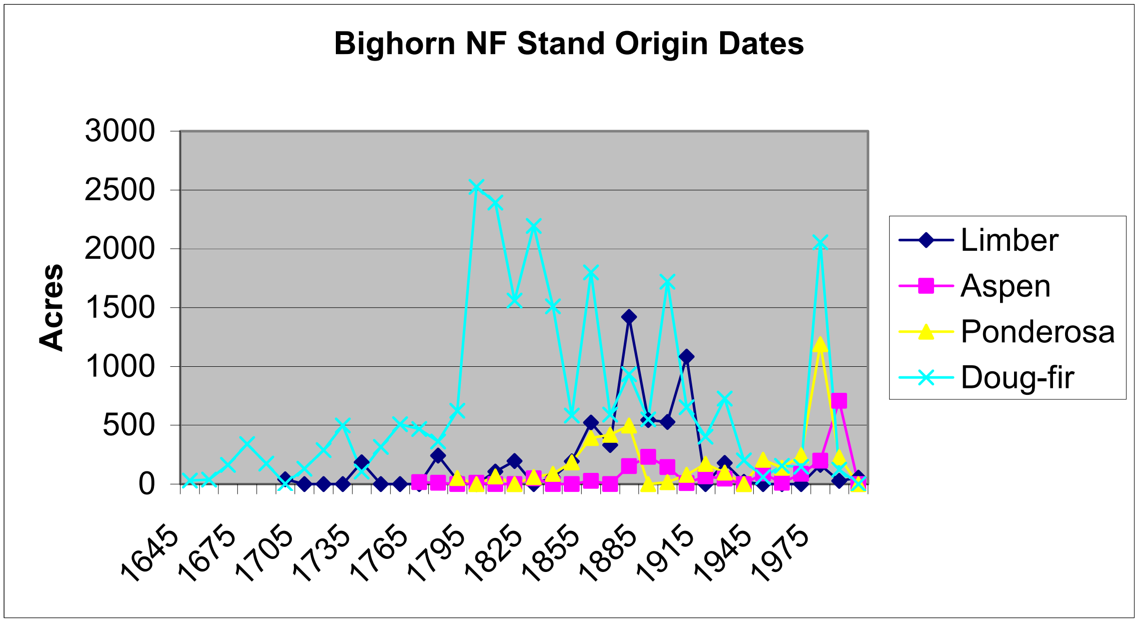
The origin dates charts, tables 13 and 14, show the stand origin dates for the forested stands on the Bighorn National Forest. Data was divided into two charts because of the large discrepancy in total acres between the major cover types. This data is either from the Stage II point information, or origin years were assigned to stands that regenerated after harvests or fires. Some of the major interpretations evident in table 13:

The spikes on the far right for aspen and Douglas-fir represent silvicultural regeneration activities.

Douglas-fir has the oldest spike of any Bighorn species.

Fires influenced limber pine stand originations in the latter part of the 19th century.

Table 13. Forested Stand Origin Dates for Limber Pine, Aspen, Ponderosa Pine and Douglas-fir on the Bighorn National Forest[7]



Some of the major interpretations evident in table 14, for lodgepole and spruce-fir, include:

The spikes on the far right represent timber harvest and large fires such as Intermission and Lost.

A large portion of the lodgepole on the Bighorn originated following large fires in the latter half of the 19th century. The high point for this spike is 1885 and 1895.

The "dip" in the 1935-1945 period represents successful fire suppression. A combination of the Bighorn being relatively "fire-proofed" by the fires of the 19th century and an aggressive fire suppression strategy caused this "void" of origin dates. Relative inactivity during World War II is also reflected in this dip.

While the spruce-fir origin date "spike" is relatively flat compared to lodgepole, it centers on about 1815, reflecting a longer life span and longer fire return interval.

[7] 33% of the total limber pine area on the forest, 31% of the aspen, 28% of the Ponderosa Pine, and 29% of the Douglas fir, is represented in this table. Each point on the lines represent the mid-point of the decade; that is, the point labeled 1975 represents all acres that originated between 1970 and 1979, inclusive. This table includes data from 1640 to 1999.

Table 14. Forested Stand Origin Dates for Lodgepole Pine and Spruce-fir on the Bighorn National Forest[8]

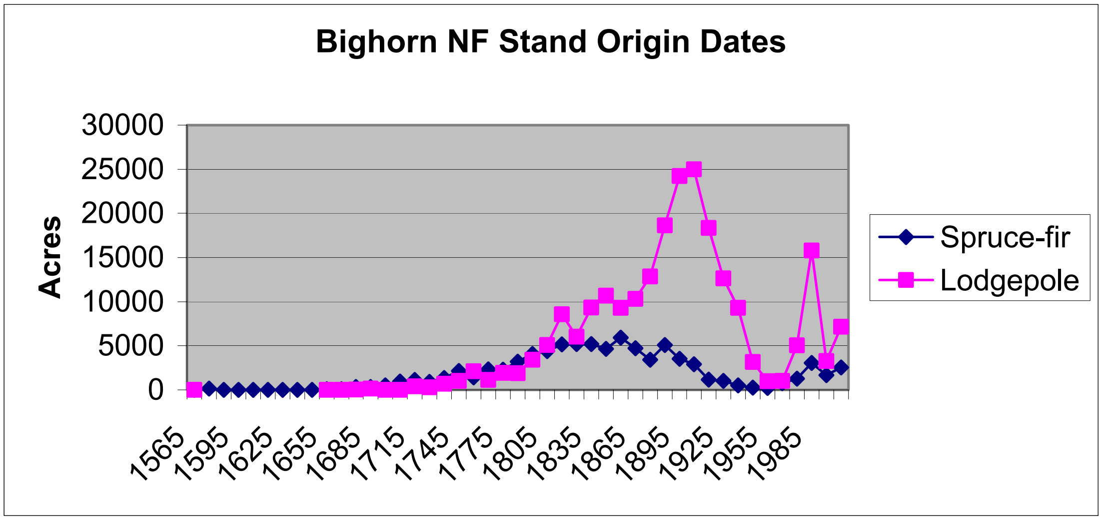


Table 15 shows the habitat structural stages for all forest cover types on the Bighorn National Forest, while tables 17 and 18 show the structural stages for individual species. Habitat structural stage provides a "coarse filter" look at habitats provided by forests. It gives an indication of forest size and density, which can be interpreted for wildlife habitat suitability. Forested stands provide an infinite variety of tree sizes and canopy densities, and to consider the amount, type, and spatial distribution of wildlife habitats, people need a simplified system to comprehend this variety. Many habitat considerations, such as amount and type of understory vegetation; size and amount of snags and coarse woody debris; and, the amount of hiding cover provided, can be approximately inferred from the broad habitat groupings described in the habitat structural stage model.

Habitat structural stages are defined in Hoover and Wills (1987). Structural stages describe the developmental stages of tree stands in terms of tree size and the extent of canopy closure. Structural stages can be considered a descriptor of the succession of a forested stand from regeneration, or bare ground, to maturity. For the purposes of a describing wildlife habitat, forest structural stages are divided into four categories, consisting of Stage 1, grass/forb; Stage 2, shrub/seedling; Stage 3, sapling/pole; and Stage 4, mature, Table 16. It is important to recognize that structural stages represent succession in *forested stands* only; the grass/forb, structural stage 1, refers only to forested stands that have undergone a stand-replacing event, and are temporarily in a "non-forested" condition. Structural Stage 1 does not include naturally occurring meadows. These areas do not have a forested cover type in the CVU database, but they are areas that were either recently burned or harvested and have a current cover type of grass, forb, bare, wood, etc. The letter in the structural stage naming convention (a, b, or c) refers to the crown density, Table 16.

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[8] 68% and 50% of the total lodgepole pine and spruce-fir area on the forest, respectively, is represented in this table. Each point on the lines represent the mid-point of the decade; that is, the point labeled 1975 represents all acres that originated between 1970 and 1979, inclusive. This table includes data from 1560 to 1999. The last data point is for 1995.

Table 15. Habitat Structural Stages on the Bighorn National Forest

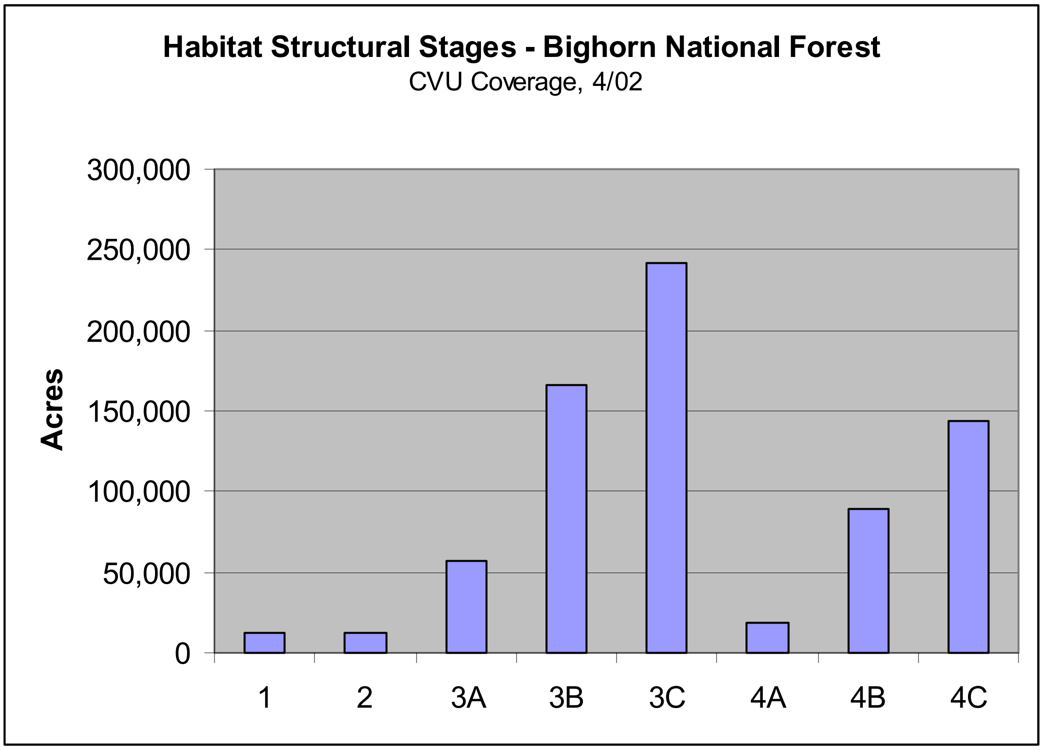


Table 16. Habitat Structural Stage Definitions, Hoover and Wills 1987

Habitat Structural Stage	Diameter	Crown Cover %	Habitat Structural Stage	Diameter	Crown Cover %
1	Not applicable	0-10%	3C	1 – 9 inches	70-100%
2	< 1 inch	10-100%	4A	9+ inches	10-40%
3A	1 – 9 inches	10-40%	4B	9+ inches	40-70%
3B	1 – 9 inches	40-70%	4C	9+ inches	70-100%

Interpretations from this table are:
The Bighorn National Forest is dominated by the 3* size classes. This is primarily due to fires in the latter part of the 1800s, which have grown into pole size (5-9” diameter) stands; and, to timber harvest in the 1960’s, which have regenerated in sapling size (1-5” diameter) stands.
Forests on the Bighorn generally grow in dense stands in the b and c crown densities. This is typical for the two major forest types, lodgepole and spruce-fir.

Table 17. Habitat Structural Stages for Lodgepole and Spruce-fir on the Bighorn National Forest

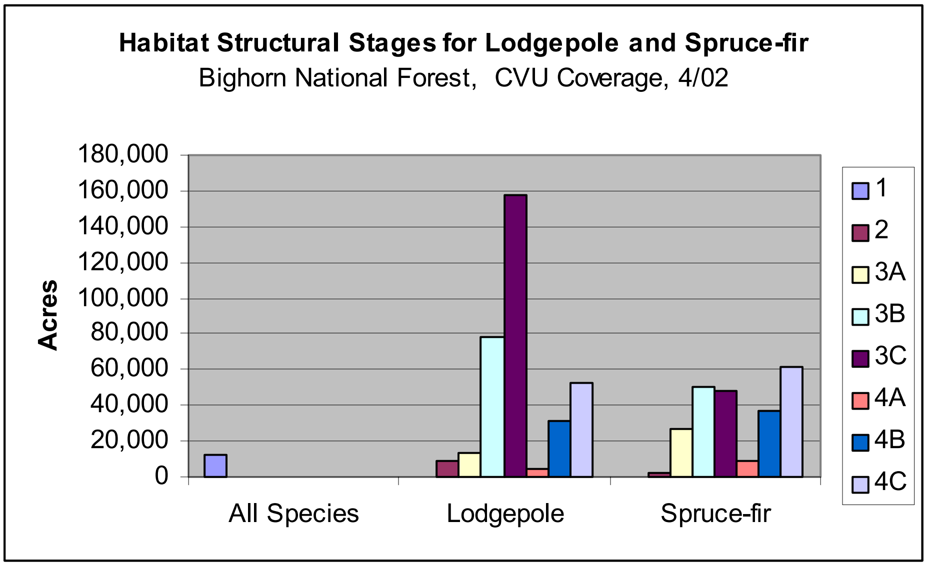
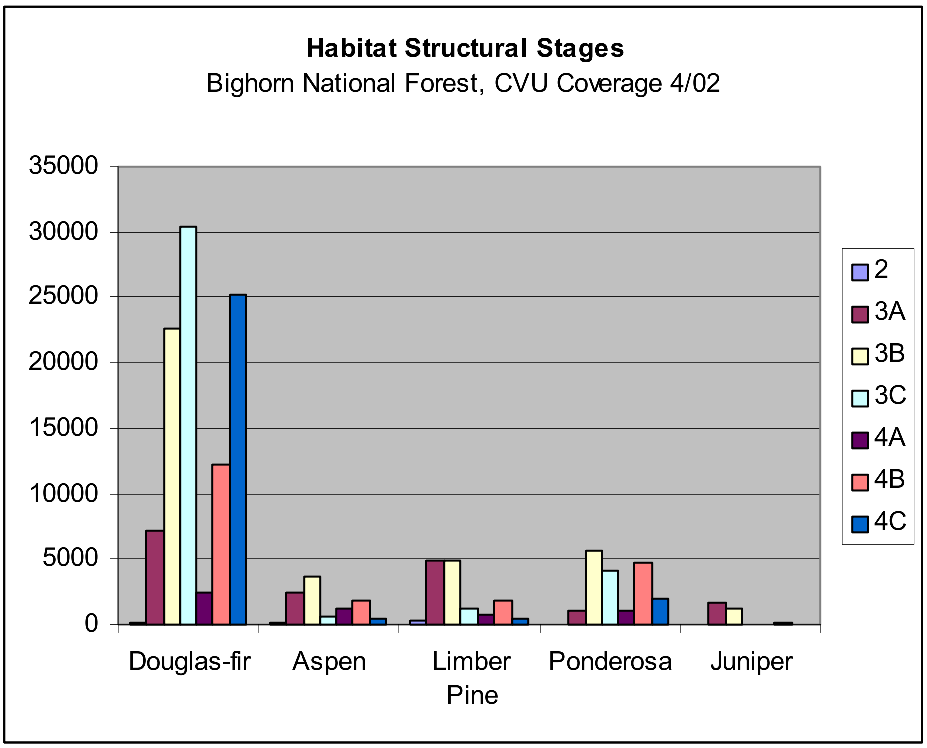


Table 18. Habitat Structural Stages for Limber Pine, Aspen, Ponderosa Pine and Douglas-fir on the Bighorn National Forest



As listed above, habitat structural stages can be used to infer specific habitat characteristics for the "coarse filter" habitat groupings. For example, table 19 shows how soft and hard snag density varies in spruce-fir forests by habitat structural stage and. There are many more snags in the 4* size classes than in the 3* size classes. Another example is shown in table 20, which lists the species composition by diameter class for habitat structural stage 4C for spruce-fir cover types on the Bighorn. Relatively short lived subalpine-fir is able to maintain co-dominance with Engelmann spruce because of its ability to reproduce in the understory. The data for tables 19 and 20 is from Bighorn National Forest Stage I permanent plots.

Table 19. Snags per Acre in Spruce-fir Cover Types on the Bighorn National Forest

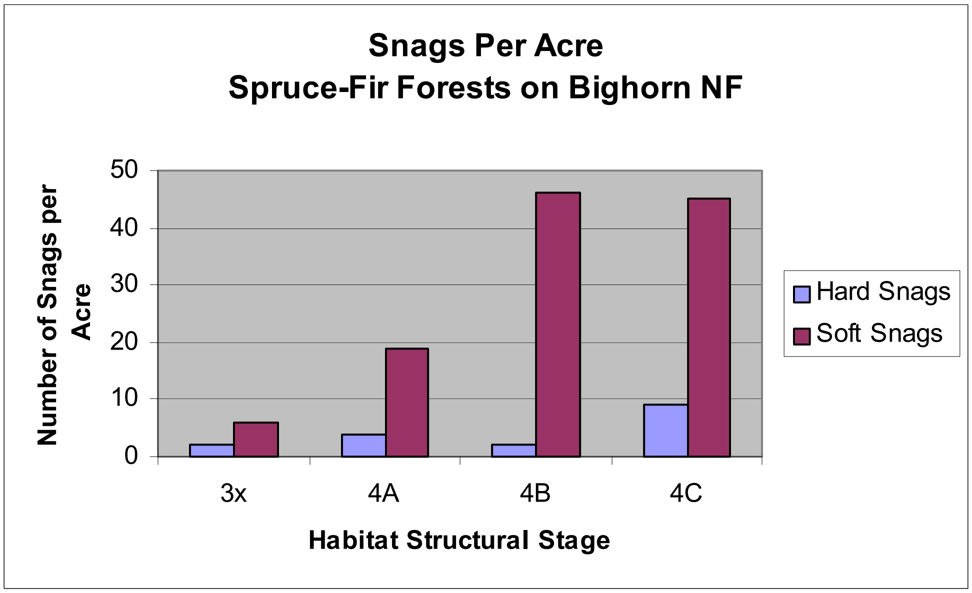
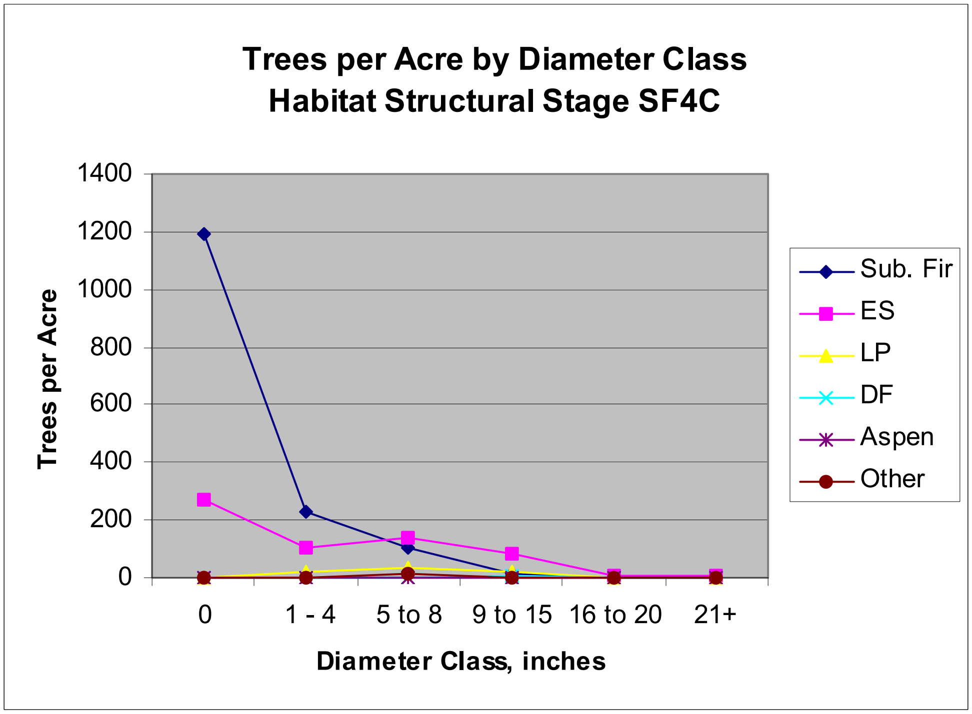


Table 20. Species Composition by Diameter Class in Spruce-fir Cover Types on the Bighorn National Forest



Concerning old-growth, approximately 36,383 acres of old-growth are needed to represent 5% of the forested area on the Bighorn National Forest, which is the current Forest Plan minimum standard and guideline. The Bighorn has informally adopted the old-growth definition in Mehl, 1992. There is no cited definition in the 1985 Forest Plan.

Within the past decade, relatively intensive old-growth surveys have been conducted in the Clear/Crazy/Powder geographic area. While that is only about 15% of the Bighorn National Forest, some of the information learned about old growth in that area can help in understanding the ecology of old growth forest-wide. Powder River has some areas of very high quality old-growth. 500 year old lodgepole pine and 550 year old Engelmann spruce were recorded, and University of Wyoming ecologist Dennis Knight stated during a 2001 field tour that the lodgepole in Powder River were the largest he has seen. At least 33% of the forested areas within Powder River qualified as old-growth when surveys were stopped. All stands that were not harvested or burned in the 1890 fire event qualified as old-growth. Piney and Rock Creek, on the other hand, have smaller, younger trees, as a general rule. This geographic area is dominated by 100 to 120 year old lodgepole, pole-sized stands because of the large portion of the area that burned in the latter half of the 19^{th} century. Because of lower site indices (which will result in smaller trees) and a higher frequency of stand-replacement fire, the Piney/Rock area has less inherent potential for old-growth habitat.

Table 21. Old-Growth Acres

Old Growth Scorecard			*Acres by Cover Type over 250 years old*				*Acres by Cover Type over 200 years old*			
Acres <30	***Acres 30-40***	***Acres >40***	***Doug-fir***	***Lodgepole Pine***	***Spruce/ fir***	***Limber Pine***	***Doug-fir***	***Lodgepole Pine***	***Spruce/ fir***	***Limber Pine***
9090	***11474***	***17336***	***2090***	***4723***	***9344***	***225***	***6579***	***18215***	***25622***	***499***
			Acres > 250 years old: 16,382				***Acres > 200 years old: 50,915***			

Table 22. Old Growth Data for Bighorn National Forest Compared to 5% Forest Plan Standard/Guideline

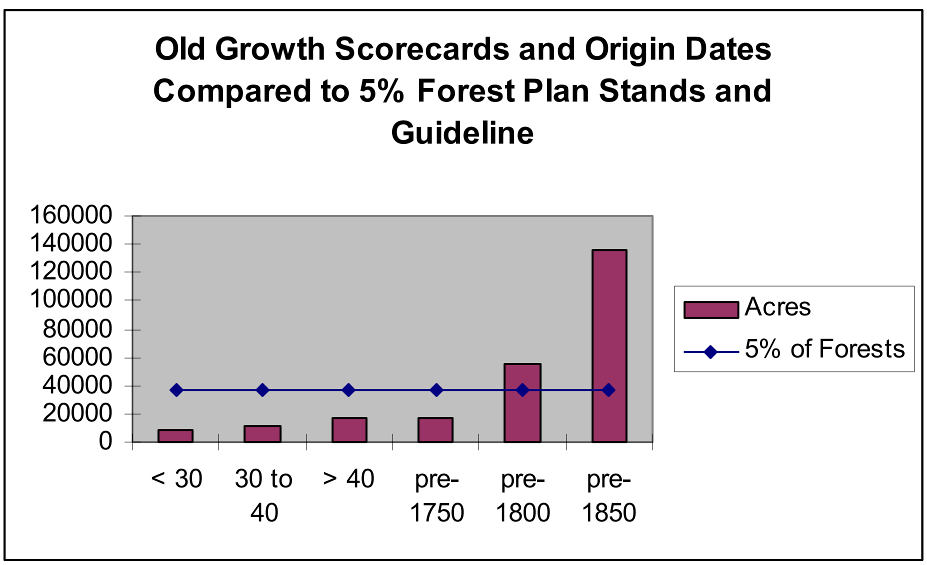


Table 23 shows how the forests in each geographic area of the Bighorn compare to the other habitat diversity structural stage standard/guide, the minimum requirement for 5% grass/forb. Subalpine forests on the Bighorn naturally are “set back” to the grass/forb stage following stand regeneration events such as fires and blowdowns. Grass/forb in this table and in the Forest Plan standard/guideline refer only to forested areas temporarily set back successionally, not to naturally occurring meadows.

Table 23. Grass/Forb Structural Stage Data for Bighorn National Forest Compared to 5% Forest Plan Standard/Guideline

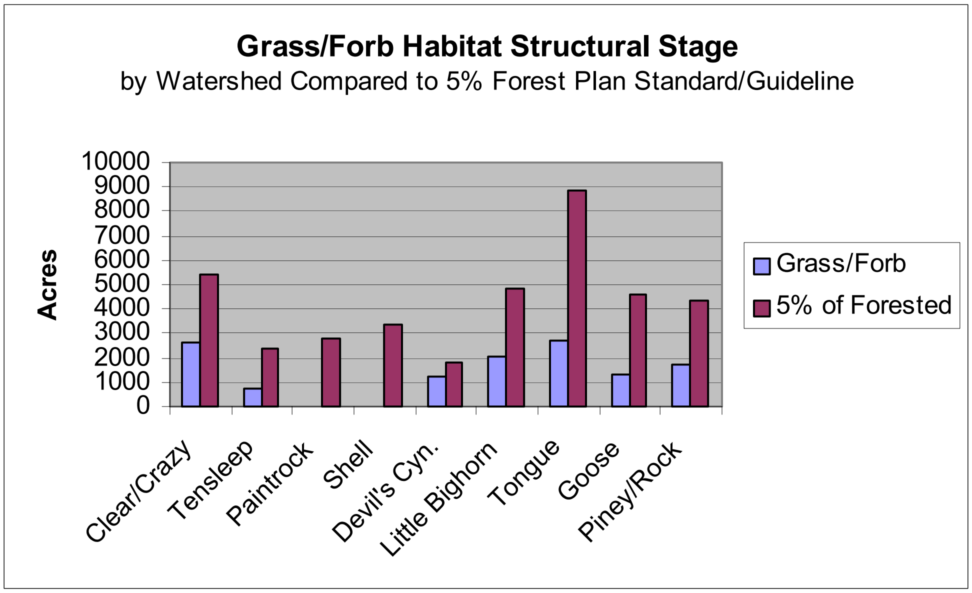


Table 24 indicates the natural range of meadows to forests by select geographic area on the forest. The meadows in this table include only the naturally occurring meadows, not transitory forest areas in temporary grass/forb structural stage.

Table 24. Forest to Meadow/Shrub Ratio for Selected Scales on the Bighorn National Forest

Geographic Area	Forested Percent	Meadow/Shrub Percent	Rock Percent
Forest Wide	65	25	10
Piney/Rock	79	4	17
Shell	49	44	7

Estimate the Range of Variability in vegetative conditions

Dennis Knight and Carolyn Meyer of the University of Wyoming Botany Department are preparing a report on the Historic Variability for Upland Vegetation for the Bighorn National Forest. It is expected that this document will be available for scientific peer review in 2002. This document will be the primary description of how vegetation changed over time on the Bighorn NF.

The overall change in the relative amounts of forests to meadows in the subalpine habitat types[9] changes very little, due to soil conditions (Despain, 1973). Thus, the current mix, of 65% forest to about 18% grass/forb meadow, fluctuates by no more than 1-2%.

Because of suppression of fires in the ponderosa pine forests along the east face of the Bighorns, it is probable that the amount of forested area has increased since 1890. Assuming a fire frequency interval of 25-50 years in those forests, at least two fire

[9] Subalpine habitats include lodgepole pine and Engelmann spruce forested areas. Douglas-fir and ponderosa pine forests are not included in this generalization.

occurrences have been missed, causing an increase in the amount of forest vs. meadow in this habitat type and an increase in the stand densities.

Riparian areas may fluctuate as large, catastrophically burned areas return to a forested condition, and more water is lost to transpiration and sublimation off of the forested canopy in the winter. This would only occur in watersheds and subwatersheds that have a large percentage of the watershed burned in the same event.

Aspen is declining for three factors:

- Long term climatic warming since the little ice age about 10,000 years ago. There was also a relative drying of the climate, since that time until the last 100 years, at which point, the climate became relatively wetter. (Knight, 1994)
- Effects on seedling survival due to wildlife and domestic livestock grazing.
- While the subalpine fire cycle has only marginally been affected (since this type has a fire frequency interval of 100-300 years and European man has only been suppressing fires for about 100 years), continued fire suppression will decrease the amount of aspen in the geographic area, since stand replacing fire events are regeneration events for aspen.

Effects from air quality

There have been no studies to date on the Bighorn concerning air quality effects on plants. An applicable study from Yellowstone National Park concluded that ozone levels are suspected to be well below the level that would affect human health or vegetation.

Risks to ecological sustainability

Vegetation in high use areas of the Cloud Peak Wilderness is threatened by overuse by people. This affects both trees (used for firewood) and long term soil productivity (soil compaction and removal of plant/litter layer in heavily used campsites.) This has been recently addressed by additional use restrictions, but monitoring will be needed to see if the restrictions are sufficient in light of increased rates of human visitation.

The cumulative effects of human intervention in the ecosystem. This includes:

- People as vectors of exotic species.
- Plant and animal species.
- Roads
- Livestock and wildlife grazing and browsing
- Timber harvest
- Fire suppression
- Recreation use